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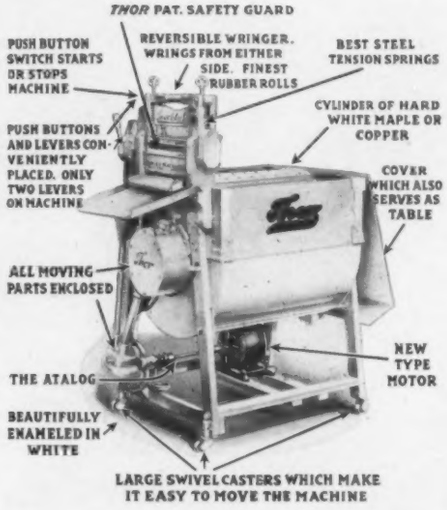
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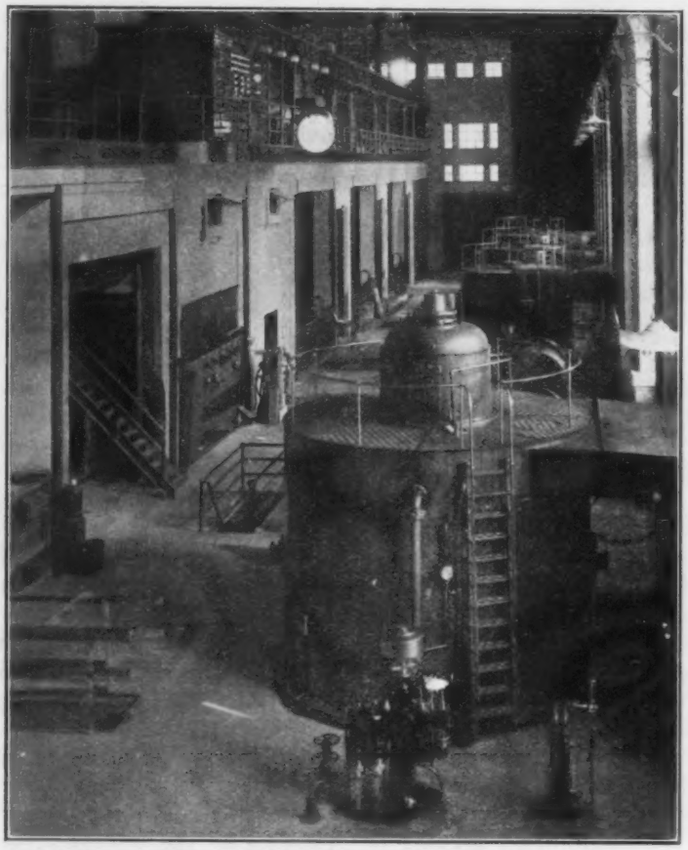
DESIGN OF TURBINE RELIEF VALVES

BY GEO. J. HENRY.

(This article is one of an occasional contribution concerning the construction and design of hydraulic apparatus. It gives details as to the design of a suitable relief valve for Francis turbines. The author is a consulting hydraulic engineer at San Francisco.—The Editor.)

In early hydraulic practice in the Eastern states only very short pipes or vertical penstocks were used and only slow moving governors. On the Pacific Coast, where the heads were higher and pipes longer, deflecting nozzles were the rule. By these, more or less water was diverted from the buckets of the wheel to compensate for load variations and regulation was thus effected without varying the water velocity in the penstock.

With the advent of electric transmission and the necessity for accurate speed control that resulted, it became necessary to secure the most rapid gate movement possible and to control larger volumes of water, frequently through long pipes. The security and continuous service demanded of Western power plants, usually installed for the maximum power output from a given watershed, caused the introduction of reservoirs and the demand that only water enough be used to carry the load at any time.



Interior of Big Bend Plant, Great Western Power Company.

It therefore became very necessary to shift the gates controlling the actual water flow and to do this over the widest range and with great rapidity. This required the compensation for or prevention of inertia effects of the water column.

Spring actuated relief valves were well known but rather imperfect devices for the handling of any considerable water quantity and not infrequently were impossible of adjustment so as to obtain anything like satisfactory operation.

Air chambers were used to some extent, their action preventing pressure rises beyond a predetermined point. But their size was large and the expansion of the contained air, after a "water ram" had occurred, caused a bad fluctuation in the pressure, oscillatory in character, first positive, then negative, on each side of the normal. Edw. S. Cobb introduced a method of overcoming the oscillation but not the first pressure impulse; and in either case the use of the air chamber required the maintenance of an air pump and was generally unsatisfactory to governing.

Any increase of pressure as the gates are closing results in excess energy being added to the wheel to increase its speed just when the reverse is wanted. Any depletion as they are opening tends to a further decrease in the wheel speed which is just the opposite of what is wanted. Hence the best results are obtainable where the pressure variations will not even be started on a gate movement. These pressure variations, due to a lack of elasticity in the water and conduit, are of extreme rapidity. Consequently any valve for the relief or by-passing of water which depends on the rising pressure to set it into operation is fundamentally wrong as the pressure will have almost invariably reached its maximum be-

fore the valve will have opened and therefore its purpose will have been defeated.

The only safe method, therefore, contemplates an instantaneous relief applied to the water column, substantially equal in degree and rapidity to the water cut off by the gates, and a positive slow closure of the relief or by-pass opening following thereafter. In this way rapid control of the water reaching the water wheel runner is secured and therefore accurate governing becomes possible. No sudden variation and therefore no material increase in the pressure will occur, the water column being retarded slowly within predetermined limits of pressure rise.

This is accomplished in the modern power plant by causing the governor apparatus which closes the water gates to also open the by-pass valve, the simultaneous movement of closing the one and opening the other preventing the sudden variation in the water velocity in the pipe and consequently its damaging pressure and spouting velocity effects. So by the slow closure of the relief or by-pass valve the required water economy is fully effected. It will be obvious that the rate of closure is the limiting factor in the pressure rise due to the velocity variation and therefore this must be made slower where the pipe is long than in the case of short pipes. The water that will be wasted through the by-pass when its valve is open is but a fractional percentage and such loss is absolutely essential to the control of the water column.

The design of the by-pass valve is just as important as the design of the main gates; it must be just as sensitive to governor control, positive and reliable and of the frictionless type; i.e. it must open or vary the by-pass outlet without sliding over any surfaces under the water pressure, but must move to or from its seat.

In tangential water wheel practice the form of by-pass valve usually adopted is a duplicate of the main needle and its seat. In turbine practice, where larger quantities are to be handled, a cylindrical form or a cross between the cylindrical and needle type is preferable.

In the plant of the Great Western Power Company at Big Bend near Oroville and of which the turbine runners were shown in Fig. 2 (Journal of Electricity, Power and Gas, Dec. 18, 1915) and described as regards their automatic hydraulic counter-balance; the type of relief valve and its connections and operation by the governor synchronous with, but inverse to the movement of the main gate is shown in Fig. 4.

The main gates of the turbine are of the balanced wicket type, each connected with the main turbine gate ring so that the partial rotation of the main ring will move them all at the same time in an opening or closing direction. This gate ring is moved by the two large horizontal oil cylinders, whose pistons are connected therewith at points diametrically opposite each other. These oil cylinders are connected in parallel with each other and oil is admitted at one end of each and discharged from the other end of each of them from the main governor; that is if the speed is too high the governor valve is shifted by its speed sensitive element so that pressure oil flows into one end of each of the oil cylinders shifting the pistons therein and thus moving the gate ring and wicket gates so that they move in a closing direction to reduce to the required amount the water flow and thus bring the speed back to normal and if the speed be too low the reverse movement takes place. While the oil under pressure is flowing to the two cylinders operating the water gates in a closing direction, it at the same time is flowing to the oil cylinder at the top of the by-pass valve and causes the by-pass valve to move downward and therefore open the by-pass an amount sufficient to discharge a quantity of water sufficient to compensate for that cut off from the turbine. The conditions of velocity and pressure in the main pipe are thus constant.

After the turbine gates have shifted sufficiently the speed sensitive element closes the governor valve, which shuts off the pressure oil supply and discharge and therefore locks the turbine gates against any further movement in either direction. Simultaneously it cuts off pressure oil flowing into the oil cylinder on the upper part of the relief or by-pass valve, preventing its further opening. The water pressure being exerted at all times against the under-side of the water piston shown below the oil cylinder of the relief valve causes a tendency for the said by-pass valve to close. It will do so at a rate of movement permitted by the rate of oil flow from the top to the bottom of the oil cylinder around its piston. Slow closure is thus insured by adjusting this part and will follow immediately after any opening movement. The same principle is employed in all six of these 18,500 h.p. units.

The connections between the governor and the by-pass cylinder and water gate cylinders, although shown in this diagram as actuated by pressure oil, may of course be brought about by lever and link connections, as for example the by-pass may be directly operated by links connected to the turbine gate ring or to the main governor rock shaft, the result being the same in each case, the pressure oil acting directly as a rigid connection actuated by the governor.

The areas of the by-pass valve and water gates and relative movements when properly proportioned and when actuated inversely by a governor of adequate sensitiveness and power will result in perfect control of the water wheel without the introduction of the damaging inertia effects so disastrous to early control of the water column in hydroelectric plants.

The governors are arranged to prevent overrunning of the speed, i.e., so they will move the gates and by-pass valve quickly and sensitively just the right amount and not have to adjust the gate position a large number of times for a single load change. The "hunting" of the speed which is caused by the overrunning of the governor, is disastrous to regulation, and therefore to service, as the voltage first varies in one direction and then in the other, overrunning the normal line in both directions frequently a number of times before coming to rest at the correct normal voltage and speed. The properly designed governor moves the gates to the proper point and holds them there and the speed, therefore, does not overrun.

It has been pointed out that a governor must be very sensitive and capable of moving the gates with great rapidity. Also in large units the inertia of the

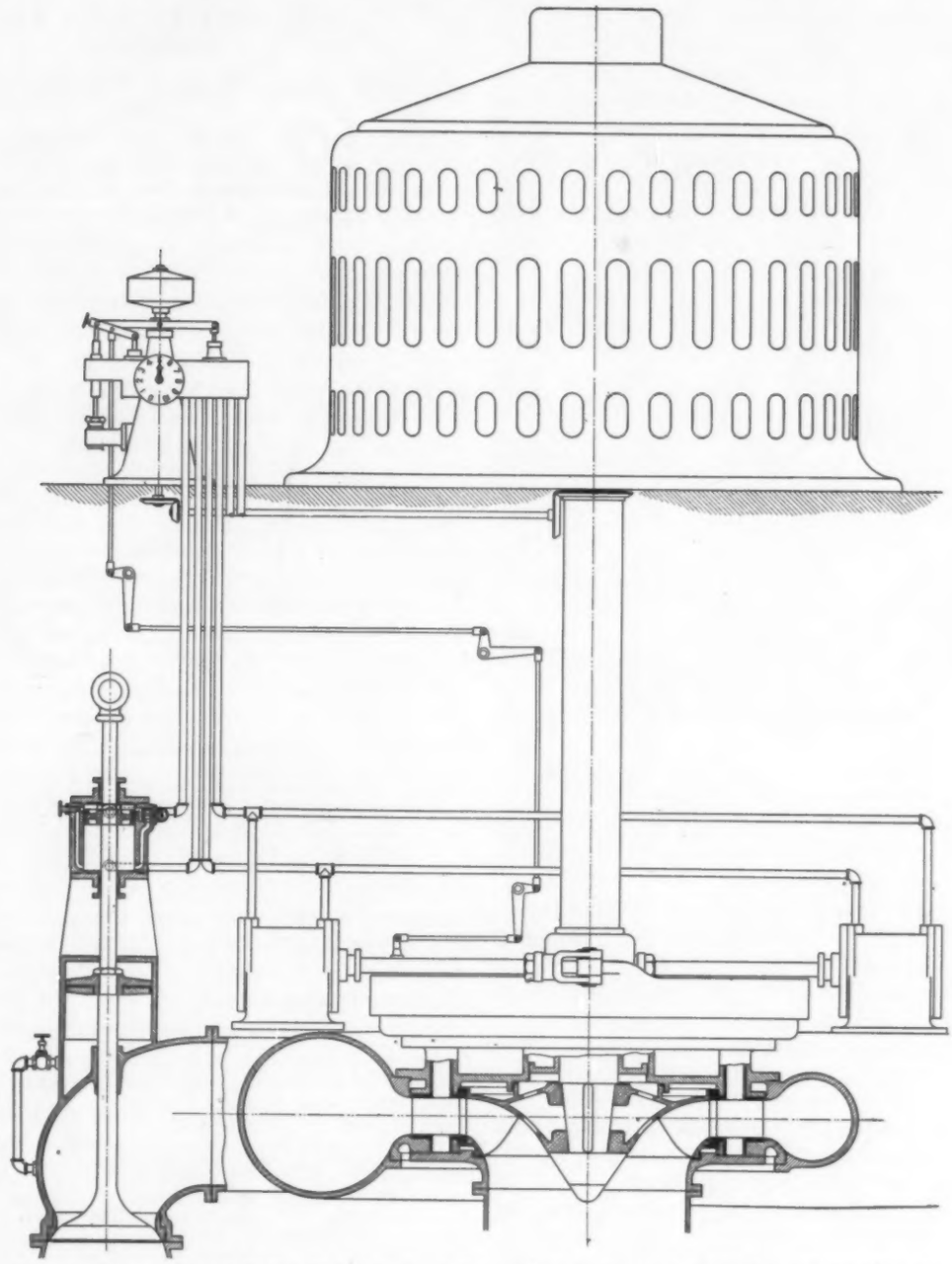


Fig. 4. Governor and Relief Valve Control Connection in Vertical Type Francis Turbine Unit.

rotating masses is great and therefore the movement of the gates will and shall be in advance of speed restoration, e.g. the speed restoration will lag behind the gate movement. It will therefore appear at once that as the speed sensitive element of the governor initiates a gate movement such movement will be progressive until the speed has arrived at normal again and unless other means are used to prevent overrunning the gates will have been quickly and fully opened or closed even for a small load change and this excess movement will quickly cause the speed to pass the normal and a reversal will occur establishing the disastrous hunting condition.

That element which is introduced into a governor to prevent this overrunning must anticipate the position which the gates should assume. In modern governors there is usually provided the speed sensitive element which controls the direction and release or restraint of oil pressure, mechanical effort or other power means actually employed to cause the movement of the gates and synchronous but inverse relief valve movement. The speed sensitive element does not control the extent to which this power shall act upon the gate valve mechanism, but in the case of an oil pressure governor, the most familiar type, and that shown in Fig. 4, it moves a valve which actually is the controller of the governor mechanism. This controller valve, although first moved by the speed sensitive element, must not now remain off of its seat until the speed sensitive element has returned to its correct or normal speed, but only until such time as the gates have arrived at their new correct position, which will be well in advance of the speed return.

An independent movement must therefore be given the controller in a reverse direction to bring it back to its new position and it must be controlled from this new position until the speed has returned to the correct point without overrunning. The lever connections

in Fig. 4 accomplish this, causing an action on the controller valve in a contrary direction to the impulse produced by the speed sensitive element. It will be apparent that if governing should now cease the speed would remain too far from normal because while this gate shifting has been taking place the speed has been departing further from normal and to bring it back the gate movement must overreach that suitable for normal speed; therefore, as the speed returns the gates must return slightly so as to keep pace with the correcting speed, and arrive at their final ultimate correct position only when the speed has arrived at its final correct value. A dash pot and spring return acting in either direction in which the curve of time and dash pot return movement must be coincident with the rate of speed return (and therefore, this curve must be a parabola) will give the best results and accurate speed return without overrunning. This dash pot element is usually built into the governor and is exposed in the upper horizontal structure of the well known Lombard governor and the parabolic rate of return is there accomplished by varying automatically the rate of oil by-passing within the dash pot. These lever connections shown in Fig. 4 between the gate ring cylinder piston and the governor are used to establish a synchronous movement within the governor corresponding with the water-gate and by-pass movement that is synchronous with the gate ring movement and are therefore under the control of the controller element of the governor and through the dash pot devices mentioned above cause the control of the controller before it has overrun the proper amount.

The third important element in governors therefore consists of a device for returning the controller whenever disturbed by the speed element, including parts which are controlled by the controller and which return the controller to inoperative position, preventing excessive movement of the governor.

Molasses as fuel for industrial purposes is being produced in Hawaii and is to be shipped to the Pacific Coast to compete with California fuel oil. Until recently 70 per cent to 80 per cent of the exhausted molasses from the Hawaiian factories was thrown away as useless. Furnaces are now being installed which burn this molasses, the heat going to furnish steam for the factory, and the ash from the molasses, which contains 33.32 per cent potash and 4.60 per cent phosphoric acid, is used as fertilizer.

A cubic yard is the quantity contained in a cube one yard on the edge. It contains the equivalent of 27 cubes one foot on the edge. As each cubic foot contains approximately 7½ gallons, a cubic yard contains about 202 gallons. This would be 6-2/5 barrels, measured in the standard liquid or "whisky barrel" of 31½ gallons. It would contain 3-2/5 hogsheads, as used for sugar, containing 63 gallons. One cubic yard of earth would make a good load for a two-horse team on a dirt road. A modern 5-ton motor truck could haul about 3-2/5 cubic yards at a load. Standard-gauge 30-ton railroad box cars, 33½ feet long, for commercial service in the United States, have interior space of about 80 cubic yards.

REPORT ON THE COLUMBIA RIVER POWER PROJECT.

Appendix B—Discharge of Columbia River at The Dalles.

(Concluded.)

BY FRED F. HENSHAW,
District Engineer U. S. Geological Survey.

Ice conditions. Columbia River freezes during extreme cold weather. It seldom freezes over with solid smooth ice, but slush ice and large cakes are frequently reported. Apparently the freezing has no effect on the relation of gage height to discharge, either at The Dalles or at Cascade Locks, as the controlling section, the rapids or "Cascades" always remain open. The discharge may be materially reduced, however, for periods of a few days at a time.

Ice obstruction below the gage at Cascade Locks was noted by the observer as follows:

1879, December 23, large cakes of ice running.
1880, December 4 to 14, river closed to navigation.
1883, February 4, gage frozen up, river closed to navigation, and boats frozen in February 5 to 26. River closed with ice at The Dalles January 23 to February 1, and February 8 to 27.
1884-85, Gage frozen up December 16 to 18 and 22. River closed with ice above locks December 16 to February 4.
1886, River closed January 17 to 29.
1887, River closed with ice February 4 to 18.
1888, Ice in river January 6 to 29, and no boat ran to The Dalles until after February 5.
1889, No boat to The Dalles January 17 to 30, but no other notes of ice that year.
1888-90, An extreme cold spell started about December 12 and lasted until about February 1, nearly 10 ft. of snow falling during this period. The river froze over January 2; both gages were frozen up January 4, and no regular readings made until January 17. On January 7 the gage below the locks was read, evidently by chopping away the ice. The river opened and a boat arrived from The Dalles February 3; river frozen again February 25.
1892, River blocked with floating ice December 21 to 23.

After 1892 ice notes are rather meager. Ice obstructions at and below The Dalles was noted by the observer as follows:

1898, Ice began running December 12; river blocked with ice December 13 to 23.
1899, Ice running January 4; river blocked January 6 to 20 and February 4 to 16; river clear of running ice February 19.
1900, January 15, drift ice running.
1901, January 10, ice running.
1902, January 26, ice running; January 27, river blocked with ice; February 9, river free from ice.
1903 and 1904, No ice reported.
1905, January 19 to 21, ice running; February 12 to 18, river blocked; February 19, river free of ice.
1906, No ice noted.
1907, January 7, ice running; January 11, river blocked with ice; February 1, ice gorge, February 9, river clear of ice.
1908, February 3 to 5, river full of running ice; February 6, ice nearly all out.
1909, January 6, ice running; January 7, river blocked with ice during night; January 11 to 27, an ice jam formed at the rapids above the station and acted as a dam, but released the stored water when the jam broke up as the result of heavy rain in Oregon; January 30 to February 3, river frozen, gage not read; December 6, thin coat of ice.
1910, January 1 to 3 and 6, ice running; January 4, thin coat of ice; January 7, river blocked with ice; no note of when it went out—probably about the 17th.
1911, January 15, ice running; January 16 to 18, river blocked with ice.
1912, January 3, 4 and 18 to 25, heavy ice running; 5 to 17, river frozen over; 24, river clear.
1913, January 13 to 25, 29 to 31, February 8, 9 and 17 to 19, ice running; February 10 to 16, river blocked.

Low water. The lowest stage recorded occurred in January, 1890, which also gives the lowest monthly mean on record. This minimum was caused by a period of extremely cold weather following the dryest year in the last half century or more, 1889. The gage above the Cascades could not be read, on account of ice, from January 3 to 15; one reading was made on the gage below the locks on January 7, and the height found to be 68.1. From this a corresponding reading

of -3.9 for the upper gage has been derived; the computed discharge is 41,900 second feet. The following note is from the report of Chief of Engineers, 1890, p. 3057:

"The river continued unusually low during the first half of the (fiscal) year, and on January 7, 1890, during the freeze-up it had fallen to 68.1 ft. on gage No. 2, a level lower by 2 ft. than any previous record. The winter was an unusually severe one in this locality."

Any sudden drop in temperature when the river is low seems to cause a marked dropping off in discharge, probably by causing ice jams which hold the water back. All the extreme low periods appear to have been caused by such cold snaps, notably those of February and December, 1884; January, 1888; January, 1890, and January, 1912.

In the annual report of the Chief of U. S. Engineers for 1879 it is stated that the lowest water of the previous winter was at a stage of 0.5 ft., at Cascade Locks, on January 18, 1879; which was the lowest for the preceding ten years but 2 to 3 ft. higher than the low water of 1859 and 1862. This would seem to indicate that in the earliest years of settlement of the country there were periods during which the stage was as low as those recorded in the past third of a century, but probably no lower.

Floods. The greatest flood on record occurred in June, 1894, and was caused by exceptionally heavy snowfall the previous winter over the entire Columbia River drainage basin. The highest stage at The Dalles was 59.6 ft. June 6, probably in the afternoon, and the corresponding discharge, 1,170,000 second feet, or 4.94 second feet per square mile. The regular reading of the same day, probably made in the morning, was 59.4 second feet, discharge 1,160,000 second feet. No flood of the last half century has closely approached this one, but that of 1849 may have nearly equalled it. The following note is found in a report made by U. S. Assistant Engineer Robert A. Habersham (Chief of Engineers Report, 1875, Pt. 3, p. 79):

"The highest freshet recorded is that of 1862. I am informed that the flood of 1849 was 5 ft. higher (above Celilo Falls)."

This would have given a discharge within a few per cent of that of 1894. This information, however, was from tradition and cannot be regarded as authentic.

The peak of the 1894 flood was higher than it would otherwise have been owing to the fact that the crest of the floods from the upper Columbia and the Snake came practically together. The highest water at Wenatchee occurred June 10 to 13, with a stage of 58.0 ft. and a discharge of about 714,000 second feet. The crest stage on the Snake at Lewiston, Idaho (26.0 ft.) occurred June 6, when the discharge, as determined from a partially developed rating curve was 378,000 second feet. The highest stage reached above Five Mile Rapids, near the mouth of the Snake River, was 55.0 ft., the maximum discharge about 415,000 second feet. Water passing Wenatchee at a given time would probably not reach the junction of the rivers at Pasco until a little later than water passing Lewiston at the same time, therefore the peak from Snake River probably preceded that from the upper Columbia by 3 or 4 days. The discharge of the upper Columbia can hardly have increased more than 15,000 second feet after the peak from the Snake had passed. Had the Snake River peak occurred 11 days earlier than it did, or on May 26, it would have encountered a flood from the Columbia of about 514,000 second feet, the discharge at Wenatchee on that date, and the peak of the great flood at The Dalles would have been reduced nearly 200,000 second feet, to less than 1,000,000 second feet. The crest would of course have been correspondingly lengthened.

In 1913 there occurred a flood practically as high as any since 1894. The peak on Snake River at its mouth occurred on May 29; the maximum height was 51.8 ft., the greatest discharge about 301,000 second ft. The Snake fell gradually, reaching a discharge of 196,000 second feet on June 15, when the upper Columbia was highest. The stage at The Dalles remained very nearly constant for two weeks; it was between 41 and 42 ft. from June 5 to 16. Had the maximum stage for the Snake coincided with that of the Columbia, as in 1894, the maximum at The Dalles would have been increased by about 110,000 second feet, or to 860,000 second feet, the eighth highest flood in the last half century, instead of sixteenth, as was actually the case.

Probability of flood occurrence. The highest daily discharge of each year covered by a record, or any other factor, may be arranged in order of magnitude and plotted in a diagram on lines equally spaced. A line connecting them will usually approximate in shape the letter "S." The difference between successive values is small in the middle of the series, but is much greater on the ends, hence the curvature on the ends of the line is much sharper than in the middle. The line thus drawn constitutes a probability curve and may be used to study the frequency with which a given value may be expected to occur, or, in other words, the number of years in which it will probably recur once in the light of past experience. If the data are sufficiently numerous, a fair approximation of the position of the line near the ends may be obtained.

The difficulty introduced by the curvature at the ends of the line thus defined may be removed by using paper ruled with lines spaced in accordance with a probability curve, or, as it is otherwise called, the normal law of error. The spacing of the lines for this paper is computed from probability curve tables, and arranged so that the line which represents the summation of the probability curve, when plotted on it is straight. If the data for any series correspond strictly with the normal law of error, the points plotted on this paper will all lie in a straight line. If the data approximate the normal law of error, the line through the points will approximate a straight line. Even though the deviation from the normal law of error is considerable, a line with only a moderate curvature may represent it fairly well.

In plotting observations on this paper the whole space is divided into as many vertical strips as there are terms, and the figure for each term, arranged in its order of magnitude, is plotted at the percentage which corresponds to the middle of its strip. That is to say, if there are 50 terms in the series, each is taken to represent 82 per cent of the whole space. The first term will be plotted at the middle of the first 2 per cent strip, on the 1 per cent line; the second term

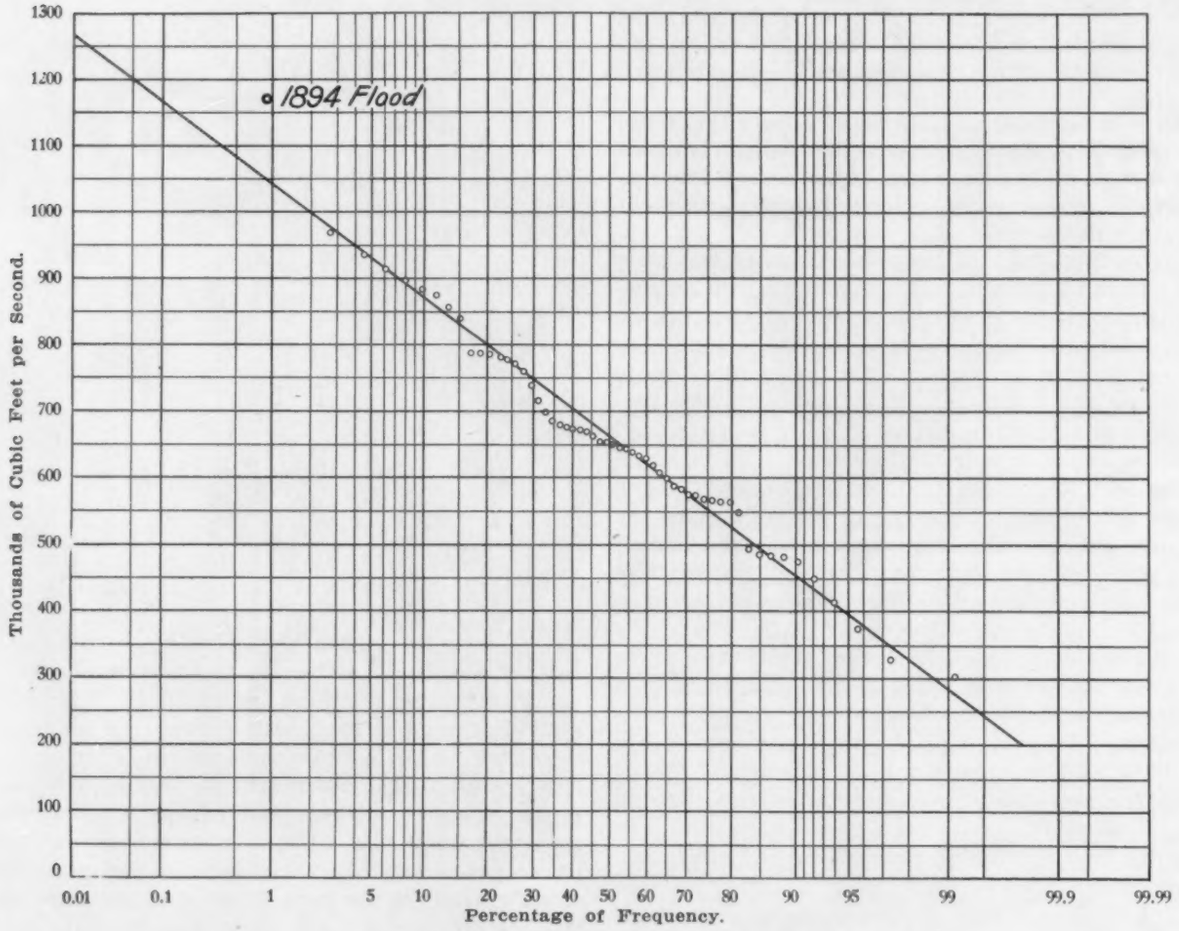


Fig. 18. Probability Diagram of Annual Flood Peaks.

will be plotted in the middle of the second strip, or on the 3 per cent line, etc. A mean line of probability, generally straight or only slightly curved, may then be drawn through these points. Regardless of the number of observations in the series, 10 per cent of same will then fall above the discharge value given by the probability line for 10 per cent, 20 per cent above the value given for 20 per cent, etc., provided the points are all normal; i. e., provided they fall on the probability line. Therefore the line may be used to determine the probable percentage of years in which a flood of given magnitude will be exceeded by reading the horizontal scale at the point where the probability line gives the discharge value.

The 56 terms representing the maximum yearly discharge values for Columbia River at The Dalles from 1858 to 1876 and 1878 to 1914 (1877 was not available when this study was made) have thus been arranged in order of magnitude and plotted on the probability paper. The result is seen in Fig. 18. The points in general define a straight line, which has been drawn by the method of least squares.

This diagram may now be utilized as follows: To find the maximum flood discharge which may be expected to be exceeded once in ten years, for instance, or 10 per cent of the time, read from the curve the value at the vertical line marked 10 per cent, which is 870,000 second feet. Conversely, it is probable that a flood of 800,000 second feet may be exceeded during 20 per cent of the years, or once in 5 years; a flood of 950,000 second feet during 4 per cent of the years, or once in 25 years, and a flood of 1,170,000 second feet about once in 1000 years. In other words, although a flood like that of 1894 has occurred once in a record of 57 years, yet if the extension of the probability curve be accepted as correct, it may be expected to be exceeded only once in about 1000 years.

Acknowledgments. Gage readings for The Dalles have been furnished by the United States Weather Bureau; those at Cascade Locks by the U. S. Engineer Corps. Special acknowledgment is due to the observers at these two points. S. L. Brooks has made the readings at The Dalles from 1893 until quite recently. The earlier readings were made on his own initiative before he made any reports to the United States Weather Bureau.

Mr. Val. W. Tomkins has read the gage at Cascade Locks since 1891.

The measurements of 1903, by the U. S. Engineer Corps, were made under the immediate direction of F. C. Schubert, assistant engineer. The cost of the flood measurements of 1913, and part of the cost of the recomputation of discharge, has been paid from the funds allotted for the investigation of the Columbia River Power Project.

Note.—Discharge records for Columbia River at The Dalles up to 1910 have been published in full in Water Supply Paper 370 of the United States Geological Survey, copies of which may be secured from the Director of the Survey at Washington, D. C.; or from the District Engineer, 416 Couch Building, Portland, Oregon.

DIESEL ENGINE PRACTICE.

BY J. E. MEGSON AND H. S. JONES.

(Continued.)

Effect of Altitude.

Due to the reduced density, that is the weight per cubic foot of the atmosphere at higher altitudes, the amount of oxygen drawn into an engine cylinder is lessened and therefore the quantity of fuel with which it will combine and burn is relatively decreased. Consequently a Diesel engine will not develop as much power at a higher elevation as it will at lower altitudes. For altitudes less than 500 ft. above sea level no reduction in horsepower or alteration of fuel consumption need be contemplated but at higher elevations a reduction in horsepower is necessary in accordance with the accompanying table:

Effect of Altitude.

Table of Altitudes in feet above sea-level; with corresponding approximate Barometric Readings, Atmospheric Pressures and proportionate Densities.

(The capacity of an internal combustion engine at higher altitudes, as compared with its capacity at sea-level, is practically proportional to the atmospheric densities.)

Altitude in Feet.	Barometer in Inches.	Atmospheric Pressure in lb. per sq. in.	Proportionate Atmospheric Density.
0.00	30.0	14.72	1.00
500.	29.5	14.45	0.98
1000.	28.9	14.18	0.96
1500.	28.4	13.94	0.94
2000.	27.9	13.69	0.93
2500.	27.4	13.45	0.91
3000.	26.9	13.20	0.89
4000.	26.0	12.75	0.86
5000.	25.1	12.30	0.83
6000.	24.2	11.85	0.80
7000.	23.3	11.44	0.77
8000.	22.5	11.04	0.75
9000.	21.7	10.65	0.73
10000.	20.9	10.26	0.70

This table shows the height of the barometer in inches and the equivalent density of the atmosphere. The horsepower output of the engine will be proportionate to the equivalent density, that is, a 500 h.p. at sea level, at 5000 ft. elevation 500 x .83 or 415 h.p. The fuel consumption of this engine, however, must also be revised, an addition of 1 per cent or fraction thereof being made for each 1000 ft. elevation.

The capacity of the cylinder also definitely limits the output of an internal combustion cylinder at any altitude, as the combustion of the fuel depends entirely upon the amount of oxygen in the cylinder, a certain amount of oxygen giving complete combustion to a certain amount of fuel oil, which in turn develops a certain amount of power. Ordinarily internal combustion engines are rated at 10 per cent below their ultimate capacity and it is dangerous and uneconomical to operate the engines at a greater load than specified by the manufacturers, although this may be possible for short intervals. The evidence of smoke coming from the exhaust shows that the combustion in the cylinder has not been complete and is the forerunner of a flame in place of the usual exhaust dry gas. This flame will burn and destroy the exhaust valve.

The electric generator manufacturers supply a generator especially rated for internal combustion engines. These machines are not capable of standing the usual overload guarantee of 25 per cent for 2 hours but instead will only carry 15 per cent overload, corresponding to the overload capacity of internal combustion engines. It would be manifestly uneconomical to purchase a generator having a greater ultimate capacity than that of the engine.

Foundation.

An important element in the erection of the Diesel engine is the foundation, which on good ground will vary, depending upon the size of engine, from 40 cu. yd. for a 100 h.p. to 125 cu. yd. for a 500 h.p. engine of the vertical type. This foundation should be constructed of concrete, 1 part cement, 2½ parts sand and 5 parts clean stone broken to pass a 2 in. ring, to be mixed wet and rammed every 8 in. depth until water appears on the surface. The templets which are set for the anchor bolts should remain open to permit ramming. Concrete should not be allowed to set hard before other concrete is placed on it, otherwise sound bonding between portions is impossible. Around each foundation bolt a wooden box approximately 4 in. square and at least 4 ft. long should be placed, the box to have a taper toward the top so that the box may be removed. If preferred, 4 in. diameter galvanized spouting may be used and left in the foundation, projecting not more than ½ in. above the concrete. Grouting should be of equal parts of Portland cement and clean sand mixed wet enough to flow readily. The grouting must fill all of the space around the foundation bolts.

Operation and Care of Earlier Type of Engines.

With the type of engine now most extensively used in the United States, that is the Diesel with the splash lubrication system, there is any amount of unpleasant work, especially when the engine requires attention inside the crank case. Few men, unless they are reasonably paid, are willing to do this "dirty" work, as it might be called, together with the fine attention required by the main bearings, keeping the shaft in line and other adjustments that are made inside the crank case.

The Diesel engines that are being manufactured today of the later type are greatly improved in this respect; the majority of them have forced lubrication so the inside of the engine is naturally cleaner for working.

One of the most important things in connection with the Diesel engine is cleanliness. Nine times out of ten if you should meet the engineer outside of his plant at any time during his watch you could safely judge the condition of his engine from his personal appearance. An engineer who lacks pride in keeping himself clean will never have a clean engine room. In a great many plants visited by the writer the engine or engines were so dirty and covered with oil that it was impossible to go near them until they had been thoroughly cleaned. Sometimes this would take a day or two. There is no leak around a Diesel engine that cannot be stopped. It is an old saying that little things make big ones and if small leaks, when they are first seen, are attended to there will be no large leaks. As a general rule all of these leaks are either a loss of fuel oil or lubricating oil, either one of which is an expense to the owner.

All true Diesel engines work along the same lines and require about the same care, but some, due to their construction, require more attention in regard to cleanliness than others. As to the operation of the engine there is but one way to be successful and that is to be clean about all your work in connection with

the engine, as dirt to any extent is the worst enemy of machinery and especially a Diesel engine. It is always wise for the engineer to be on duty in ample time to carry out the necessary preparations for starting the engine without undue haste.

Some instructions will tell the engineer to place his engine in starting position as soon as the engine is shut down. I do not agree with this. It is well to get the engine on the right revolution for starting but not to bring up to the starting position until almost time to commence operation. If the engine is placed in starting position and left over night, with some types, the starting valve is held open during the time by the starting valve cam. This valve is closed by a spring and as there is always more or less moisture in the starting air it will cause corrosion around the valve stem and often times the valve will not close as quickly as it should, causing a false start. It is the writer's belief that just this trouble was often the cause of broken shafts in the early days of the Diesel engine. If the engine is left just back of starting center until the time of starting when it is turned up into starting position it will move this valve and break the corrosion if it has set in.

There are so many different designs of the Diesel engine being built at this time that it is hard to describe the starting moves of each engine, but the result of all is the same. After the engine is placed in starting position, the engineer is ready to prime the fuel oil pump or start a flow of oil through the pump to the telltale, according to the design of the engine, it being necessary to get a solid stream of oil at the telltale before the pump is ready to operate. If air should be in the oil line or pump it is doubtful if the engine will pick up or start work at once and it often is the cause of a false start and the loss of starting air, which, of course, is undesirable in connection with the Diesel engine. The engineer should always see that the circulating water is running through the engine before it is started; if this should be neglected and the water is low in the cylinder and turned on after the engine is started it is often the cause of cracked cylinder heads, as the piston of the Diesel engine only has to make a few strokes before the heat of the compression and the burning oil would raise the temperature of the head to such a degree that water coming in contact with it would cause it to crack.

With all Diesel engines air bottles, or tanks, or vessels as they may be called, are shipped with the engine forming part of the installation. These bottles are all tested to 3000 lb. and as a general rule are shipped from the factory containing air at 1200 lb. per sq. in. Some builders ship six bottles, some three. Where there are six bottles four are for starting and used for this purpose only. The other two are used for atomizing or spray air. Two starting bottles are used at one time and one spray bottle where six bottles are provided. The header which connects the bottles together is always provided with a valve between the starting set and spray bottles. This valve should always be closed when starting the engine so that regardless of the decrease of air in the starting bottles the spray bottle pressure will be kept as high as possible and must always be at least 100 lb. above the compression in the engine cylinders. If the pressure in the spray bottle should get lower than the pressure in the cylinder when the fuel needle opens, there would be insufficient spray air pressure to blow the fuel into the cylinder and the heat from the compression would be liable to ignite the oil in the atomizer and cause severe trouble.

After the engine is started it is always wise to refill the starting bottles as soon as possible and close the valves tightly to prevent loss of air. Then all lubricators should be looked after to see that they are doing their work and kept well filled. The circulating water should be regulated according to the load on the engine so that it is not above 130 degrees Fahrenheit or cooler than 90 degrees Fahrenheit.

With engines of the enclosed crank case type and splash lubrication many engineers have found it troublesome to keep the water and oil at the proper level and the right mixture. Practically all of the engines of this type have a 1½ in. plug in the top of each door. If before the engine is started the engineer is sure that the oil and water are about the right mixture and height in the crank case he should, after starting the engine, remove the plugs and by putting his finger into the hole in the door he will soon become accustomed to the amount of oil and water that splashes so that any time while the engine is running he can do this and feel sure as to the amount of oil and water in the engine. This has been found to be the simplest and most satisfactory way to obtain this information.

[To be continued.]

LETTER TO THE EDITOR.

Vocational Guidance.

Sir: The editorial on "Vocational Guidance" in your issue of December 11, has touched a responsive chord. The periods of "financial retrenchment" are occasions of much hardship to many of our engineers, and this I think absolutely unjust. When you consider the intrinsic value of the achievements, which achievements would be impossible without our engineers, it is certainly not right that they and their families should suffer through a "shut down of the plant." It is seldom that the financiers suffer any great amount of personal discomfort through a financial depression, and certainly the men whose brains have "created the mechanism" should be as fortunate.

Your suggestion of the appointment of a joint committee of national engineering societies to analyze this phase of engineering betterment is timely. In these days of close analysis of all human conditions towards the end of betterment of such conditions, the requirements of our engineers should not be lost sight of.

Your remark as to materially stabilizing the engineering profession, "no matter what the financial stresses might be," is a splendid thought, and should be held until the end has been fully accomplished.

Personally I would be very glad to assist in any way that I can towards improvement of conditions for engineers, so many of whom, in addition to being consistently underpaid, are improvident, and lack business sense.

Very sincerely yours,

J. PAULDING EDWARDS.

THE NEED FOR A CONSISTENT GENERAL STATE POLICY AS TO PUBLIC UTILITIES.

BY CLYDE B. AITCHISON.

(After outlining the relations which he thinks should exist between the public utility and the community, the author states his objections to granting local franchises by municipal authorities. He shows how the monopolistic character of the business should govern regulatory policies. A clear insight is given into the principles which determine the actions of the Oregon Railroad Commission, of which the author is a member. This paper was presented at a luncheon of the Portland N. E. L. A. and A. I. E. E. Section, December 8, 1915.—The Editor.)

There are undoubtedly many more public utility users than there are taxpayers; and the public utility's bill has to be met each month, while the tax collector is settled with but twice a year. There is not a man, woman, or child in any remote or undeveloped portion of our state whose life, according to present-day conventions, is not shaped by the conveniences which have become necessities afforded by the public utility. The business of public service is so interwoven into the warp and woof of the body politic that the man from Mars might expect to find the state itself performing all these utility functions, either directly or through its municipal agents, as a part of its duty to provide for the general peace, health, safety and convenience. And, indeed, in many lands, as to many forms of public service, the state has undertaken these public functions; while in our country some utility services, such as the transportation of the mails, are exclusively reserved for the nation; and there is no form of public utility service in which the nation, some of the states, or many municipal governments, are not engaged. The business performed by the public service corporation is essentially governmental in character, and it is only because it has been deemed best as a matter of legislative policy to entrust the business to private hands, as trustees for the state, that the private corporation finds itself engaged in this quasi governmental calling.

It might be expected that the state, and every state, which had determined to entrust such far-reaching powers of government into private hands would have formulated a clearly defined, well considered, logical policy which it had determined to follow in its dealings with the private agencies which perform such important functions for the commonwealth. It might be expected that all of the relations between the state and the private corporation engaged in the public service would be adjusted with a single thought kept clearly in mind; that these public services might be performed in the most efficient, economical, and equitable manner for the whole body politic. It might be taken as assumed, if we did not know the contrary, that the ultimate welfare of the body politic would be the single thought underlying the whole system of administration, so far as this subject is concerned.

It is obvious that there is no such concert of motives. A private concern which would similarly drift along without a well defined central idea or business policy and which failed to subordinate immediate and minor matters to the achievement of the ultimate object would soon be in the breakers. In the dealings between the states and the utilities, we find confusion, a division of authority and responsibility among departments of the government, an entire and open lack of co-ordination, no developed central idea of what the state really expects of its public utilities, or as to what is essential and what is non-essential in the details of the relationship.

If we analyze the situation, the inconsistencies of our present system will be found due to the division of authority, and the tendency to regard that which is immediately possible and apparently advantageous, and which can be done legally as more desirable than the less clearly defined ultimate object for which public service is performed. But what we can do, legally, today, is one thing; whether, in the long run, we should do it, is another. Often today's advantage is tomorrow's loss; a skirmish has been won and a campaign lost.

The tardy recognition of the intimate connection between the functions of the utility and the welfare of the community, and then, latterly, a sudden appreciation of the importance of the relationship, has resulted in much recent legislative action, often seemingly taken on the spur of the moment to meet a particular situation which has presented itself. Constitutional limitations have made it impossible for us to avoid a division of jurisdiction between the state and interstate commerce, between matters of state police authority and those which are purely municipal in nature. Diverse jurisdictions, each dealing with a single phase of the activities of a utility which is serving all of them—each political authority anxious to make the best possible showing before its own citizens and entirely heedless of the effect of its acts upon the citizens of other jurisdictions—manifestly present an administrative system not conducive to a consistent and statesmanlike general policy. This division of jurisdictions will always be with us in some form, and it is, and will be, an extremely difficult task to put into operation any policy as long as authority is so split up and men continue to be short sighted and selfish. It does not seem impossible, however, to minimize the conflicts, and possibly we can work out a policy which can be lived up to with comparative consistency.

The utilities are not entirely blameless in this regard. Every regulating officer is familiar with the manner in which upon occasion one jurisdiction or tribunal has been played off as against another. The utility's policy has not always been the far-sighted and consistent one of regarding the ultimate good of the community as more important than the momentary advantage of the utility.

For the purpose of this discussion it must be taken as assumed that the state has decided to continue the general plan of depending upon private enterprise in the main for the operation of its public utility service, but has not waived its right to engage in the same business when deemed best. Indeed, when the interests of the body politic can best be served by a municipal ownership and operation of any particular public service, or all public services, the right carries with it the duty. This general policy necessarily implies such an adjustment between the state and the private

citizen who engages his personal services and money, that each will derive the utmost benefit from the transaction consistent with the correlative and opposing rights of the other party.

Manifestly, a well rounded policy would take into consideration such matters as the granting of the right to engage in the public service; the insistence upon financial methods which will insure the permanency of the enterprise; the requirement of a progressive service standard and elastic service limits, and of rates which will compare favorably with those for which the state or municipality could supply itself, adjusted with the inexorable equality of governmental action. The relationship between the state and the utility has already been said to be based upon convenience; and when the state desires to resume the performance of the service, it should be permitted to replace the existing utility upon terms which are fair and just. It would defeat the policy to make the business of public service so undesirable, hazardous or unprofitable upon the whole that private citizens will not engage their time or means therein.

To slightly paraphrase a portion of an address by Commissioner Prouty, as Chairman of the Interstate Commerce Cammission, to a gathering composed of railroad and public service commissioners from the whole United States.

The public service corporation is a public servant. That phrase comes from the Supreme Court and has been for a quarter of a century in the mouth of everybody who has had to do with this subject. It comes, as time goes on, to take on a different meaning. Originally the people said, "It is our servant; therefore we can kick and cuff it ad libitum." But it is coming to be understood that just as a servant can only properly discharge his duties when he is suitably fed, clothed and housed, so the public service corporation can only properly discharge its duties when it receives proper treatment from the public.

To go a step further than the chairman in his figure: Our servants owe us the duty of obedience, loyalty, willing effort and of non-interference with our internal affairs. We may abuse our present hired help, but only by being just to our present servants, paying living wages, and giving reasonable comforts can we expect others who are not under compulsion to enter our employment and labor loyally in our interest. There is a well marked distinction between a course of conduct on the part of the state administration to which existing public utilities may have no legal right to complain, and the results of such a policy. No one can be forced, in the future, against his will, to enter the public utility service. He will enter the service or keep out of it, largely according to the manner in which existing utilities are dealt with. This will not be overlooked in the construction of a rational administration policy.

Of course the state must have the right to say who should engage in a business governmental in character. The grant of special powers with respect to the exercise of the right of eminent domain, the nature of the utilities as part of the highway system, the similarity of service charges to taxes, and, above all, the essentially governmental character of the business, permit and require the exercise of a sound discretion on the part of the state in admitting its citizens to such an undertaking.

But this discretion is often exercised in a capricious manner. Local franchises become a matter of bargain and favoritism. They are granted or withheld for reasons which do not purport to have any connection with the welfare of the larger government. For example: An insignificant village in Washington, located at a strategic point, held up the building of a link in a transcontinental railroad system until its extravagant local demands were met—demands which ultimately were shifted to citizens in other governmental subdivisions of the same state. Twice recently Oregon communities which had not attained the dignity of calling themselves cities blocked projected public utility lines which would have served a large portion of the county, including several more distant cities, by demands that they be given equal rates and service conditions with the metropolis of the state. Instances close at hand might readily be multiplied, but would be merely cumulative upon the points that, as at present administered, the system of granting local franchises by municipal authorities or at municipal elections, as the result of competition and dicker, is inconsistent with the development of the resources of the state as a whole, and with the carrying out of any consistent and well rounded policy. The present system may be said even to defeat its own ends. The municipalities often get the worst of the barter. One famous franchise in a large city in Oregon, voted as an initiative measure with great hurrah to a prospective competitor of an existing public utility, is of such a character as to some of its terms that if it had been granted by a council or adopted otherwise than through the use of the initiative with no opportunity for amendment in details, all the black faced type in the printer's font would not have sufficed for unscathing denunciation of the officers who had so betrayed their trust. A business-like policy would call for the formulation of a common-standard, model form of local franchise, which would be fair and would need as little local adaptation as possible, but which could be altered when special treatment was necessary.

Particular attention should be given to the length of the term for which the franchise is granted. There is a danger which is often not perceived in the limiting of the term to too short a period, just as there may be danger from granting a franchise for an undue length of time. A medium ground is presented by the indeterminate franchise, already adopted in many states, which runs during good behavior and has coupled with it a perpetual option on the part of the municipality to recapture the privilege granted, upon reasonable terms. In any event, the duration of the franchise is important enough to receive more attention in a utility program than has been given it in this state.

This commonwealth is not a Hanseatic league of free cities. Municipal authorities often assume such is its character. It is a state, a sovereign, which, for the more convenient administration of its affairs, has created the governmental agencies we call counties, cities, towns, which are its creatures, and which it may in its sole discretion (only restricted by its own

constitution as to manner of exercise of the power) change or abolish entirely. The principal is the state, the municipality the agent, which acts in these governmental matters for its principal and whose authority is special. It will doubtless continue to be expedient that the granting or withholding of franchises to use the public ways shall be vested, at least in the first instance, with local authority; but the power should be exercised with a view to the welfare of the state as a whole, to further the interests of the commonwealth, and not for merely local ends. In saying this, we are quite aware of the constitutional restrictions upon the power of the legislative assembly as to municipal charters, peculiar to this state. But the underlying principles are in nowise altered, and the central policy can be enforced by the legislative authority of the state speaking through the electorate of the state, as to which the constitutional restriction is inapplicable, notwithstanding the home rule charter provisions in the constitution.

The state cannot abdicate its rights of sovereignty, and should not, if it could, in any manner bind itself from resuming the governmental powers which it has delegated to private hands. When the time comes for it to resume those functions, both justice and self interest dictate that the treatment afforded the utility already in the field should be fair.

It may be legally possible for a municipality to ignore the fixed investment made by an existing utility, to duplicate its plant, to divide the territory with it, and by sheer force of governmental power as against private strength actually turn an investment which it has permitted, or perhaps even invited, into mere junk. But what is legally possible and temporarily advantageous is not always in the long run the best thing to do. Such acts always have a tremendous effect in determining the course of intending investors, both in the particular community, and also in the state as a whole which permits its municipalities, thus virtually to confiscate property. The contingency of the state or its municipal subdivisions desiring to recapture the rights granted is presently well taken care of in the laws of other states, in a manner which places safeguards around the transaction and insures proper protection to all interests, public and private. The course to be followed in event of the resumption of these governmental functions is an element in the public utility program which cannot be omitted without impairment of the whole plan.

(To be continued.)

Calculations for natural light are based on an average value of sky brightness of 250 candles per sq. ft. of window surface in any direction from which the sky can be seen through a window. Excluding particularly stormy days, the minimum value of sky brightness is 100 candles per sq. ft., less a reduction of 25 per cent for losses in the windows. This brightness value, multiplied by the part of the window area through which sky is visible from a given point in the light space, gives the available candle power through the window. This candle power, divided by the square of the distance between the given point and the window, gives the foot-candle intensity of the illumination at the given point.

LANE COMMENDS THE FERRIS BILL.

In the course of his annual report as Secretary of the Interior, Franklin K. Lane offers the following comment regarding the Ferris Bill:

The Ferris bill was called for by the fact that existing legislation permitted only a revocable permit to be granted for such use, and this was regarded by engineers and financiers as too tentative and hazardous a tenure where millions of money were needed for the installation of the necessary plant.

The Ferris bill meets this difficulty by proposing a lease of these lands for a definite term of fifty years. The objection is made that the lands should be given outright. To this there are several answers of substance: No enlightened government gives such a franchise. There is danger, very real danger, too, of a complete monopolization of such power sites if the lands go forever from the people. The value of water-power is not yet fully realized, and its full value can not be known at this stage in our industrial life. The purpose of the Government in transferring these lands is to secure their use, because it does not choose to use them itself, but the time may come when it may be most desirable to the full development of our life that they shall be operated by the nation or the states or the municipalities in the states, and to transfer them forever would cast a burden upon the future which would be unforgivable, and is, moreover, unnecessary. The people desire these lands used, not held as a mere basis for speculation in stocks or bonds. Where there is need for such a plant the lands should be available on most generous terms.

At the end of the fifty-year period what becomes of the plant? If it has been so managed as to best serve the country there would be no reason why the holding company should not have a new lease. If it had not been so managed the plant should be bought at its value by whoever the new lessee might be, or by those who took over the lands on which it was situated, the state, for instance. In other countries the plant is generally made to revert to the government at the end of the period without cost; and when it is realized that by establishing an amortization fund of one-half of one per cent each year the full expenditure can be refunded in fifty years, the difficulty of caring for the investment should not be insuperable.

The state owns the water, it is said, and should therefore command the right to the use of the land. This line of reasoning leads to an impasse. We are not considering rights, but what course is wise. Quite plainly the state can not command the use of the land and it is not proposed that the nation shall command the use of the water, for no one can have the land at all unless he first gain the right to use the water from the state. We have given no other land to the state except for the sustaining of schools and colleges or for reclamation. If a state wishes coal land, it must buy it. The traditional policy of the government has been to deal directly with the people in disposing of their domain.

The fear is expressed that by the imposition of charges for the use of the land an undue and unjust burden will be cast upon the people. The basis of this fear has not been discovered. Congress may, of course, if it so desires, fix absolutely the charge that shall be made, and if this were done the charge should be so low as to make the added burden upon the consumer, if any, an infinitesimal one; perhaps first a free period when no charge would be made, and then one-tenth of a mill per kilowatt hour for a period and two-tenths of a mill later.

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The index to the volume which is completed with this issue has been printed and will be sent without charge to those subscribers who request it.

Perpetual Peace a Christmas Wish

Of all gifts from whatsoever source, none would be more acceptable at this season than an assured peace. This we wish our readers, both individually and collectively. The price of peace is preparedness, which in turn consists in an educational and commercial program commensurate with a nation's greatness; intensive expenditures for peaceful pursuits at least equal to those which might, as has been shown, be demanded by war.

Conquest, that is, leadership through peaceful pursuits in which the worker is protected, will leave those nations who choose this course far ahead in the race and will bless and benefit, whereas the so-called victories of war are but a blight which must be destroyed before the people affected can again evidence a healthy growth.

A world weary of warring awaits that mighty influence which shall convert the energies of war into those properly directed pursuits of peace; that will destroy strife in the revelation of a universal brotherhood.

The price of this peace, perpetual and progressive, is preparedness. Not necessarily consisting alone of armaments and trained men, but certainly in the prosecution of a campaign of publicity that those desirable peoples in congested countries may learn of the liberty and opportunities of the New World continent where immeasurable resources await development, and millions of acres but men; land and resources obtainable at but minimum expense and without conquest, requiring merely obedience to the Scriptural injunction, "Go up and possess it." Preparedness should likewise be sought in the expansion of markets through the aggressive development of international trade.

All encouragement possible should also be given to engineering bodies which, working in national agreement and for the good of all, interpret and report progress in common terminology, giving the result of their labor to the entire world. And our new-old wish of "Peace on Earth, good-will toward men," naturally suggests a possible and essential unity of men and the elimination of enmity.

Remedying Winter Unemployment

Closely allied to the deplorable fact that "periods of financial retrenchment find the engineer either embarrassed in the practice of his profession or completely without employment," regarding whose correction a suggestion was recently made in these columns, is the annual question of unemployment during the winter months, due to the general cessation of engineering work. This latter question affects not only the engineer, but also a large number of men dependent upon his activities. A good suggestion as to its remedy is contained in a "Report on Winter Unemployment" by J. P. Newell, E. T. Hopson, et al., a special committee of the Oregon Society of Engineers.

This report shows that the disadvantages of winter operation are greatly overestimated in the Northwest. The same is manifestly true throughout the Pacific Coast, where the Japan current greatly moderates the temperature.

Winter cessation of work in the West is largely

the result of Eastern habit. This is but another example of the influence of locality on conditions. The cost of protection against the slight interruption to engineering construction due to inclement weather in California, Oregon and Washington can be more than compensated by a slight reduction in wages, by the lower cost of obtaining labor during the winter months and by the greater efficiency of the workmen in their desire to hold their jobs.

The report suggests that winter operation be given the preference in both public and private work by deferring summer work wherever it is possible to do so without sacrificing other interests of preponderating importance. Furthermore, as regards unemployment during hard times, "common business prudence dictates that there should be the least possible expenditure for public improvements during good times, and a maximum during hard times. By taking advantage, as it were, of hard times, they will quickly disappear, the over-supply of labor will be adsorbed and the haunting fear of idleness and destitution will be at least partly dispelled."

Relief from Waterpower Discouragement

The prospects for legislative relief from the present intolerable restrictions to the development of waterpower are excellent during the present session of Congress. Although it is likely that war matters will occupy much of the attention of the legislators, yet the demand for action on this matter is probably strong enough to force a vote, especially as the question was not decided at the last session. Furthermore, developed waterpower is essential to national preparedness.

This point has been brought out by both the Secretary of War and the Secretary of the Interior in their annual reports. Each urges that suitable laws be enacted. The former refers to the electric fixation of nitrogen as an important requisite to national defense. He states:

Military effectiveness requires ample quantities of nitrogen, and the proper appreciation of national security behooves us to make provision for an adequate supply in time of war. Our only present source of supply is the natural nitrate beds of Chile, which is time of war might be shut off from us. Obviously in the matter of munitions, especially where the source is so limited and localized, we should neglect no provision so easily available as this to make the country self-sustaining. Plants producing nitrogen for industrial purposes in time of peace would be a great national asset in view of their availability to supply us with the necessary nitrogen in time of war.

Secretary Lane, while less specific, is more suggestive in the opening portion of his report, when, after justifying our pride in those "adventures which make the game of opening a new country worth while," says:

"War is no longer a set contest between more or less mobile armed forces, but an enduring contest between all the life forces of the contesting parties, their financial strength, their industrial organization and adaptability, their crop yields, and their mineral resources, and that it ultimately comes to a test of the very genius of the peoples involved. For to mobilize an army, even a great army, is now no more than an idle evidence of a single form of strength if behind this army the nation is not organized. An army is no longer merely so many rifles and men, cartridges and horses; but chemists and inventors, mines and farms, automobiles and roads, airships and gasoline, barbed wire and turning lathes, railroads and weather prophets—indeed, the complete machinery of an industrial nation's life."

Secretary Lane further argues that this country possesses both natural resources and natural ability—lands, waters and mines, inventors, chemists and engineers—which need only be put to use to become effective. He deplores non-use and waste. He shows that with suitable legislation our phosphate deposits, oil lands and waterpower can soon be put to the highest uses.

Such substantial development of unworked resources requires workable laws. Neither secretary minces his words in referring to the present situation. Secretary Garrison says that "the evils of the existing law must be conceded, a consideration of the General Dam Act itself reveals them, and the lack of development under it in the face of a substantial demand makes proof of them." He strongly urges the passage of a measure which will permit and encourage the development of the waterpower of our navigable streams. Secretary Lane likewise states that his department has several hundred dam sites "which should be freed from withdrawal and turned into use just as quickly as possible."

The navigable stream situation is admirably cared for in the Shields-Adamson bill which has been introduced in both branches of Congress, in much the same form in which it failed to pass at the last session, except that it contains a few strengthening amendments. This is a splendid, practical measure, and will not only encourage waterpower development, but will incidentally render many streams navigable by means of private capital instead of public taxation.

The public lands waterpower question is in the same impossible status in which it was left at the last session. Mr. Ferris has introduced the Ferris bill in the unworkable form in which it pased the House, and Senator Myers has introduced the bill in the Senate just as it was reported by the Public Lands Committee to the Senate calendar. While this is a great improvement over the House bill, it is still sadly in need of amendment to make it workable.

While Secretary Lane comes vigorously to its defense, the Ferris bill is still unsuited to right Western wrongs. As "a measure intended to promote hydroelectric development on public lands," its provisions defeat its purpose. It offers neither sufficient inducement to private initiative, nor sufficient security to private capital to engage in the public service. In short, it will not work, as has been repeatedly demonstrated in these columns.

There are good grounds for the belief, however, that the Ferris bill will be amended on the floor (it being understood that there will be no committee hearings on waterpower bills), so as to be practical. Congressmen have learned the commonsense viewpoint of this question and appreciate the criminality of non-use. Waterpower developments are neither war brides waiting at the church, nor war waifs on the doorstep. They are legitimate factors in our industrial development and are worthy of every encouragement.

PERSONALS

Allan Talbot of the Yosemite Power Company is a recent visitor at San Francisco.

R. C Bulgar, connected with the Yosemite Power Company, is a recent arrival at San Francisco.

P. M. Longan and **F. G. Hamilton** of the Mount Whitney Power & Electric Company, are recent arrivals at San Francisco.

G. W. Brewer, manager Western States Gas & Electric Company at Richmond, spent a few days at San Francisco last week.

Paul Shoup, in charge of the Southern Pacific Railroad's electric system of Los Angeles is a recent visitor at San Francisco.

Delos A. Chapelle, president of the Southern Sierras Power Company, and **C. P. Poole,** chief engineer, were at San Francisco last week.

J. T. Whittlesey, electrical engineer for the Universal Electric & Gas Company is expected to return to San Francisco this week from the East.

J. C English of the J. C. English Electric Company, of Portland, Oregon, has returned from an extended business trip through the Eastern part of the United States.

H. S. Perkins, coast representative of the J. H. Parker Inc., porcelain manufacturers, has just returned to San Francisco, after spending a week throughout the Southwest.

A. J. Meyers, Pacific Coast manager Wagner Electric & Manufacturing Company, will return to San Francisco about the first of the year, after an extended trip through the Southwest.

L. F. Parkhurst, engineer in charge of the manufacture of heating devices of the General Electric Company, Pittsfield, Mass., left for the East after spending a few weeks on the Coast.

K. E. Van Kuran, district manager of the Westinghouse Electric & Manufacturing Company of Los Angeles, has returned south after spending the latter part of the week at San Francisco.

D. P. Mason, formerly general storekeeper of the San Joaquin Light & Power Company of Fresno, has recently been appointed manager of the Midland Counties Public Service Corporation.

W. F. Neiman, formerly manager City Electric Company at San Francisco, has recently been appointed manager of the commercial department Universal Electric & Gas Company at San Francisco.

C. B. Hawley, vice-president and general manager of the Inter-mountain Electric Company of Salt Lake City, recently returned from a trip to Hot Springs, Va., where he attended the jobbers' convention.

L. S. Hooper of the New London Ship & Engine Company of Gratton, W. Va., has returned home via Vancouver, B. C. Mr. Hooper has been looking over the Diesel engine situation on the Pacific Coast for the last year.

C. H. Thordarson of the Thordarson Electric Company of Chicago, has returned home after closing up his affairs at the P. P. I. E. **A. S. Lindstrom,** his Pacific Coast representative, expects to open an office at San Francisco about the first of the year.

H. L. Haehl, consulting engineer at San Francisco has been elected president of the San Francisco association of members of the American Society of Civil Engineers, and **Jerome Newman,** chief engineer of the Harbor Commission, vice-president.

Fong Kim Poon, minister of communications, department of engineering, Peking, China, is visiting the United States to study the electrification of railways and will make a report to his government when he returns to China. Mr. Poon who has been studying the conditions on the coast for the past few weeks, will leave for the East shortly.

J. L. White, manager of the Oregon Power Company at Albany, has been appointed a member of a Commercial Club committee which will investigate the possibility of establishing a pulp and paper mill in Albany. The company has been approached for tentative figures covering 1500 horsepower for operating the proposed plant.

H. H. Burton has resigned his position in the legal department of the Utah Power & Light Company at Salt Lake City to accept one with the Electric Investment Company at Boise, Idaho, as office attorney. Mr. Burton is a graduate of Bowdoin college in 1909 and of the Harvard Law School in 1912. After leaving law school he entered the office of Gage, Wilbur and Wachner of Cleveland. Mr. R. A. Wilbur of that firm later took the position of general attorney for the Utah Power & Light Company and Mr. Burton moved to Salt Lake City with him.

Julian Bamberger, president of the Salt Lake & Ogden Railroad Company, and vice-president of the Salt Lake Terminal Company returned recently to Salt Lake City from a four weeks' visit in the East, where he setudied terminal facilities and other features of railroad improvement work. While away Mr. Bamberger placed an order for six all-steel passenger coaches for the Salt Lake & Ogden Railroad, especially for the travel to the Lagoon summer resort, which is located on their line. These cars will have a seating capacity of eighty passengers and a large standing capacity. They are expected to be delivered here not later than May first. Mr. Bamberger also made a study of block signal systems as his line expects to install automatic block signals on the sections of single track still remaining between Salt Lake and Ogden some time during the coming summer.

MEETING NOTICES.

Oregon Society of Engineers.

The Oregon Society of Engineers held a meeting December 16th at 8 p. m. in the grill room of the Portland Commercial Club. The speaker of the evening was Geo. E. Hardy, executive secretary of the Portland Chamber of Commerce. A buffet luncheon was served and smoker afterwards. Mr. O. Laurgaard gave a short report of the Western States Irrigation Congress at San Francisco.

Pacific Service Minstrel Show.

A large and appreciative crowd enjoyed the annual minstrel show and jinks of the Pacific Service Section of the National Electric Light Association, on the evening of December 13th. The program was contributed almost entirely by members of the Pacific Gas & Electric Company, including the orchestra, quartet and minstrels. Moving pictures of "Every Husband's Opportunity" were also used to depict the advantages of electricity in the home. A startling reproduction of "Stella" and a take-off on the presentation of plaques by the exposition officials were notable features of the program. R. E. Fisher, as chairman of the entertainment committee, was tendered a vote of thanks by the executive committee because of his efforts in making this affair so successful. At the next meeting, on Jannary 11th, Dr. Albert Palmer will talk on "The Efficiency of Men."

Electrical Development and Jovian League.

The December 15th meeting was the last for the year, President Geo. C. Holberton presiding. The first order of business was the reading of the secretary-treasurer's report, which showed the league to be in a strong financial position. W. L. Goodwin then reported for the nominating committee as follows: President, E. M. Cutting; vice-president, C. C. Hillis; secretary-treasurer, J. W. Redpath; executive committee, R. M. Alford, R. F. Behan, W. S. Coleman and S. A. Hamilton. There being no opposition ticket these nominees were declared elected. The meeting was then turned over

to Samuel Taylor, who as chairman of the day introduced Mr. Geo. A. Knight. Mr. Knight made a vigorous defense of the lawyer, showing the law was an essential part of the science of government and should be handled by those familiar with its practice. He showed the dependence of a stable government on the legal profession and concluded with a strong plea for patriotism.

Jovian Electric League of Southern California.

The weekly luncheon of the League on December 15, thanks to the Herculean and able efforts of C. W. Bliven, chairman of the Day, was transformed into a typical Christmas festival with a Christmas tree hung with gifts and the presence of a liberal, jovial Santa Clause in the person of J. Harry Pieper. After Tribune Holland had disposed of the routine business of the day, Santa Harry distributed, with appropriate remarks, gifts befitting some well known characteristic of the recipient. For example, he gave a football to Morphy, dog to Monehan, stuffed stocking to Murray, rattle box to Foster, doll to Kierrulf, old man to Pomeroy, baby shirt to McHugh, telephone to Matthew, horn to Sinsabaugh, stockings to Lewis and Arbogast, doll to Loomis, horn to Case, baby jacket to McLean, drum to Davis, ball to Dietriech, baby shoes to Rawls, potato masher to Holland, top to Northmore, pig to Sessions, doll to Bliven, apron to Loewenthal etc. Then out of a paper screen jumped dainty Ethel Burrows and Alice Lewis and entertained with jolly songs, while Stone's orchestra furnished the musical accompaniment.

The Wass-Hael.

The fifth annual festival of Wass-Hael was appropriately observed by over a hundred electrical men of San Francisco on Saturday afternoon, December 18th. An excellent luncheon, good entertainment and fine fellowship contributed to an afternoon of enjoyment. Those present were as follows:

Affolter, P. H.
Alvord, R. M.
Balzari, R. A.
Batkin, Dr. F. A.
Beardsley, E. W.
Behan, R. F.
Bendel, Wm.
Bibbins, T. E.
Brenneman, J. B.
Briggs, W. W.
Bridges, John
Brown, J. Q.
Brown, E. C.
Brownell, John R.
Carleton, F. V.
Cobliegh, A. H.
Cole, Waldo C.
Collins, T. E.
Collins, F. W.
Cooper, N. K.
Daley, H. H.
Dazey, K. I.
Decker, Peter
Drendell, A. E.
Eltringham, R. L.
Fischer, Harmon F.
Frickey, R. E.
Fuller, A. R.
Garin, J. A.
Gregory, S. B.
Halloran, A. H.
Hamilton, Sam
Hanbridge, W. S.
Hand, H. C.
Hardy, C. E.
Harris, D. E.
Harriman, Murray
Harrison, Frank
Helfrick, Lew
Herbert, Claude
Herr, J. A.
L'Hommedieu, Wm.
Hoxie, H. H.
Hunt, C. W., Jr.
Hunt, J. H.
Jackson, H. F.
Johnson, W. C.
Kahn, R. T.
Kendall, E. J.
McKinley, Walter L.
Lauritzen, Hal.
Lee, W. E.
Leggett, F. H.
Lindstrom, A. S.
Linge, Wm.
Mason, D. P.
Moore, Dr. H. W.
Murphy, R. W.
Myers, Romaine W.
Mynard, C. E.
McCray, W. J.
Neeland, Wm.
Nestor, C. E.
Newbert, L. H.
Orrick, M. S.
Pahl, A. J.
Parkhurst, L. F.
Phelps, N. D.
Poss, F. H.
Pottinger, J. J.
Quinn, F. J.
Rice, F. S.
Rosenblatt, G. B.
Rosenlund, E. T.
Rowe, Purcell
Russell, Sam
Sanderson, H. E.
Shreve, E. O.
Simpson, T. W.
Somers, L.
Sproul, E. R.
Steel, Miles F.
Strong, E. B., Jr.
Tallant, C. H.
Taylor, Sam
Thompson, A. V.
Thompson, C. E.
Thompson, Jos.
Thompson, W.
Trygoning, Fred
Westbrooke, C. P.
Wilcox, A. E.
Wilson, A. R.
Williams, Geo. I., Jr.
Whitesel, H. H.
Woodward, Harry
Wooster, M. E.
Younghohm, Al.

NEWS OF THE WASHINGTON PUBLIC SERVICE COMMISSION.

The commission has held the rates charged for both residential and commercial lighting by the Puget Sound International Railway Company, lessee of the Everett Railway, Light & Water Company plant, to be unjust, unfair and unreasonable. The order of the commission cancels the present rates for both classes of electricity and puts into immediate effect a new schedule of rates on the basis of 7.7 cents per kw. h. for the first 20 kw. h use.

The commission has reduced the lighting rate of the Pacific Power & Light Company, in Walla Walla and North Yakima, from 10 cents per kw. h. per month for the first 30 kw. and 8 cents for the power used above tnat amount to 8½ cents for the first 60 kw. h, 6 cents for the second 60 kw. h. and 5 cents for any amount over 120 kw. h. Proportionate reductions are made for smaller towns which the company serves, including Pasco, Kennewick, Toppenish, Prosser, Dayton, Sunnyside, Pomeroy, Granger, Grand View, Wapato, Mabton, Richland, Waitsburg, Zillah, White Bluffs, Beverly, Kiona, Benton, Finley, Ringold, Wahluke, Huntsville and Dixie. Regarding irrigation, rates the commssion allows the former quoted rates to remain in effect, but provides that schedule be used "on the active load rather than the connected load." The reduced rates, the commission estimates, will yield a net return of 5.7 per cent, with a possible increase to 6 per cent as the patronage increases.

The commission will hold telephone hearing, involving the physical valuation and both long distance and local exchange rates of the Pacific Telephone & Telegraph Company at Tacoma, January 24th. This will be one of the largest public utility hearings ever held in the Northwest, and the most momentous telephone inquiry ever held in the history of the state, marking the first attempt on the part of the commission to place a valuation on the properties of a telephone corporation, and determine the just and fair rates such corporation is entitled to charge. One of the questions to come up for determination by the commission at this heering is the question of where toll service commences and exchange service ends. At present a 5 cents terminal charge is credited to the local exchange for conducting the toll business, or long distance service, and the propriety of this charge will come up for determination.

NEWS OF ARIZONA CORPORATION COMMISSION.

The commission has ordered that on or before the first day of January, 1916, all electric utilities operating in Arizona shall install such meters or other apparatus as may be necessary in determining the total amount of electrical energy generated and the total amount of electrical energy distributed; that such instruments be read and the energy generated and distributed be determined at frequent and regular intervals, and that permanent records be kept of the results of such readings. In the case of street lighting circuits and of sign lighting installations in which a definite amount of current is used for a definite number of hours each day, a complete record of such current and such hours of use will be deemed a compliance with this order.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

The Southern California Edison Company has filed with the commission an application for authority to issue and sell $500,000 face value, 5-year 6 per cent debentures, up to and including July 1, 1916.

The commission has authorized the Oakland, Antioch and Eastern Railway to issue notes to certain stockholders who have advanced $90,911 to the company, and secure the same by pledge of company's bonds on a basis of 80 per cent face value of notes to 100 per cent face value of bonds.

Thc eommission has issued an order granting the Roseville Telephone Company an extension of time to December 31, 1916, within which time to issue stock previously authorized by the commission.

The commission has authorized the Corona Home Telephone Company, Riverside county, to issue 16 shares of stock in lieu of stock heretofore issued without commission's authority.

NEWS NOTES

ILLUMINATION.

SCOBEY, MONT.—It is stated that the Scobey Electric Light Company is planning to enlarge their plant at this place.

EUGENE, ORE.—The city has purchased the distributing system of the Oregon Power Company in Eugene for $150,000.

REDDING CAL.—The board of trustees will receive bids up to December 27th, for the construction of a street electric lighting system.

WENDELL, IDAHO.—The council has contracted with the Great Shoshone and Twin Falls Water Power Company for the installation of a new lighting system for the town.

TROPICO, CAL.—The board of trustees has awarded the contract for street lighting on San Fernando boulevard to the Keystone Iron Works for 32 cast iron standards, complete, and installation, $2104.

SANTA ANA, CAL.—Sealed bids will be received by S. H. Finley, chairman of the ornamental lighting committee, up to December 27th for installing an ornamental street lighting system in Santa Ana.

BAKERSFIELD, CAL.—Bids were opened by the county supervisors for a franchise to erect a gas line from this city to Wasco. The only bid entered was by C. B. Colby. The matter was referred to a committee.

CULVER CITY, CAL.—Venice and Culver City Chambers of Commerce held a meeting in Culver City at which a movement was started recommending the illumination of Washington Boulevard from Los Angeles to the sea.

AZUSA, CAL.—Upon being advised that the bid of the City Electric & Supply Company of Riverside for an electrolier lighting system for Azusa was irregular, the Board readvertised for bids for the work, bids to be received up to December 27th.

VENTURA, CAL.—At a meeting of the trustees a motion was made that the city attorney be instructed to draw up plans for the submission of a bond issue of $65,000 for a municipal lighting plant, but the matter was laid over until the first of the year.

ESCONDIDO, CAL.—A committee of the Ramona Chamber of Commerce has taken up with the Escondido Mutual Water Company the matter of supplying light and power to Ramona. Ramona's Chamber of Commerce seeks to secure more water, electric light and power for the valley.

PHOENIX, ARIZ.—The boards of directors of the Chamber of Commerce, Merchants' and Manfacturers' Association and Young Men's Business Association, met with representatives of the Pacific Gas & Electric Company to discuss the matter of an electric light and power supply for Phoenix. The matter was laid over for further consideration.

ORANGE, CAL.—The ornamental lighting project advanced at a meeting of the advisory committee of the board of trustees, when a resolution was passed recommenging that the trustees proceed to install a lighting system under the district plan. The proposed district extends from Grand street to Santa Fe on Chapman and from Maple to Almond on Glassell street.

TRANSMISSION.

BAKERSFIELD, CAL.—J. B. Carter of the San Joaquin Light & Power Company is running a survey for two miles of line to connect with ranches in the Button-willow District.

EVERETT, WASH.—H. K. Owens, consulting engineer, Seattle, for E. C. Money, Everett, has filed a water claim on the North Fork of Skykomish River, for development of power.

KINGMAN, ARIZ.—The Desert Power & Water Company has received the contract for supplying power to Golconda. It is the plan of the company to extend the line to Chloride without interruption.

EVERETT, WASH.—F. L. Hammond has filed a claim with the county auditor for a power site in Sultan River to be used for a mining power site and electric power. A damsite is at the west end of a small canyon.

EVERETT, WASH.—E. L. Hammond has filed a canyon dam site claim with the county auditors. He locates and claims 100,000 miners' inches of water in the Sultan River to be used for a mining power site and electric power.

SAN BERNARDINO, CAL.—Application has been made to the board of supervisors for a franchise to construct and maintain for 50 years an electric pole and wire system along the public roads and highways in San Bernardino county. Sealed bids will be received for the franchise up to December 27th.

PHOENIX, ARIZ.—James R. Girand, engineer, working on the project which has for ultimate purpose the supplying of electric power to every mining community in Arizona and Southern California, by building dams in Colorado River, has sent out a surveying party and in a few weeks the work of building the first power unit, 21 miles from Peach Springs, Ariz., will begin.

FLORENCE, ARIZ.—Mayor P. H. Fulton is in receipt of a report from W. R. Elliott, engineer for the Salt River Valley Water Users' Association, in which he states the reclamation service has approved the proposed contract between the state, town of Florence and Salt River Valley Water Users' Association for electric power from the Roosevelt project. The right of way across the Pima Indian reservation is the only matter to be adjusted, then will follow a bond election for installing light and power plant.

LOS ANGELES, CAL.—The public service commission has decided that the Pacific Light & Power Company and the Los Angeles Gas & Electric Corporation should have until January 4 in which to inform the city authorities whether the companies will sell those portions of their distributing systems which the city would like to acquire in the Hollywood and Garvanza-Highland Park districts. If the power companies do not confer with the public service commission on or before January 4th it is proposed to start installing a municipal system in the Hollywood and Garvanza-Highland Park districts.

TRANSPORTATION.

MARTINEZ, CAL.—Preliminary negotiations have been started here by Judge Clifford McClellan of San Francisco for the construction of a 7 mile railroad linking this city with Concord and connecting with the main line of the Oakland, Antioch and Eastern Railway at that point.

SAN FRANCISCO, CAL.—The contract for the construction of a section of the Church Street Municipal Railway, between Eighteenth and Twenty-second streets, has been awarded by the board of works to the Contra Conta Construction Company for $120,500.

CORVALIS, ORE.—The council has passed a franchise for the Southern Pacific Company and work of electrification between Whiteson and Corvallis will be started soon.

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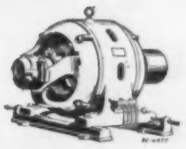

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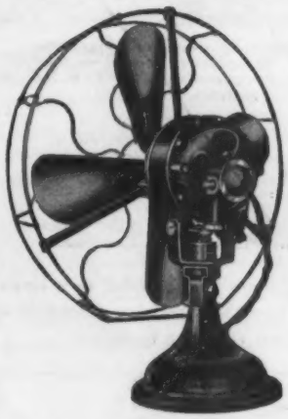

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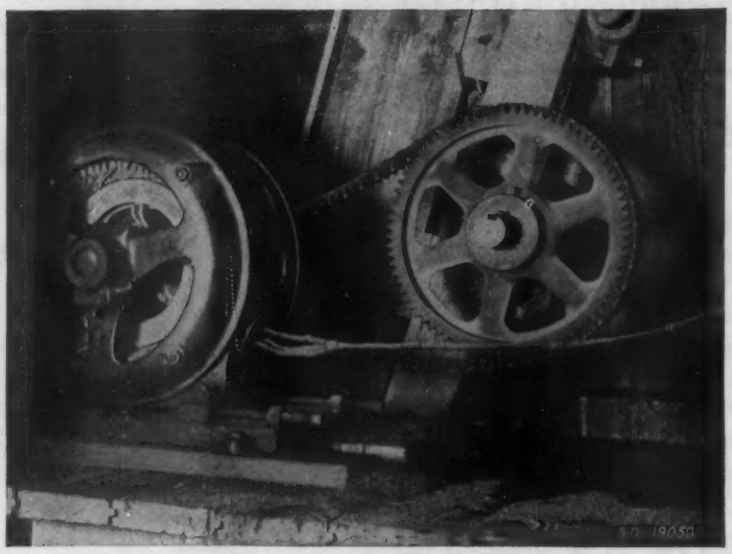

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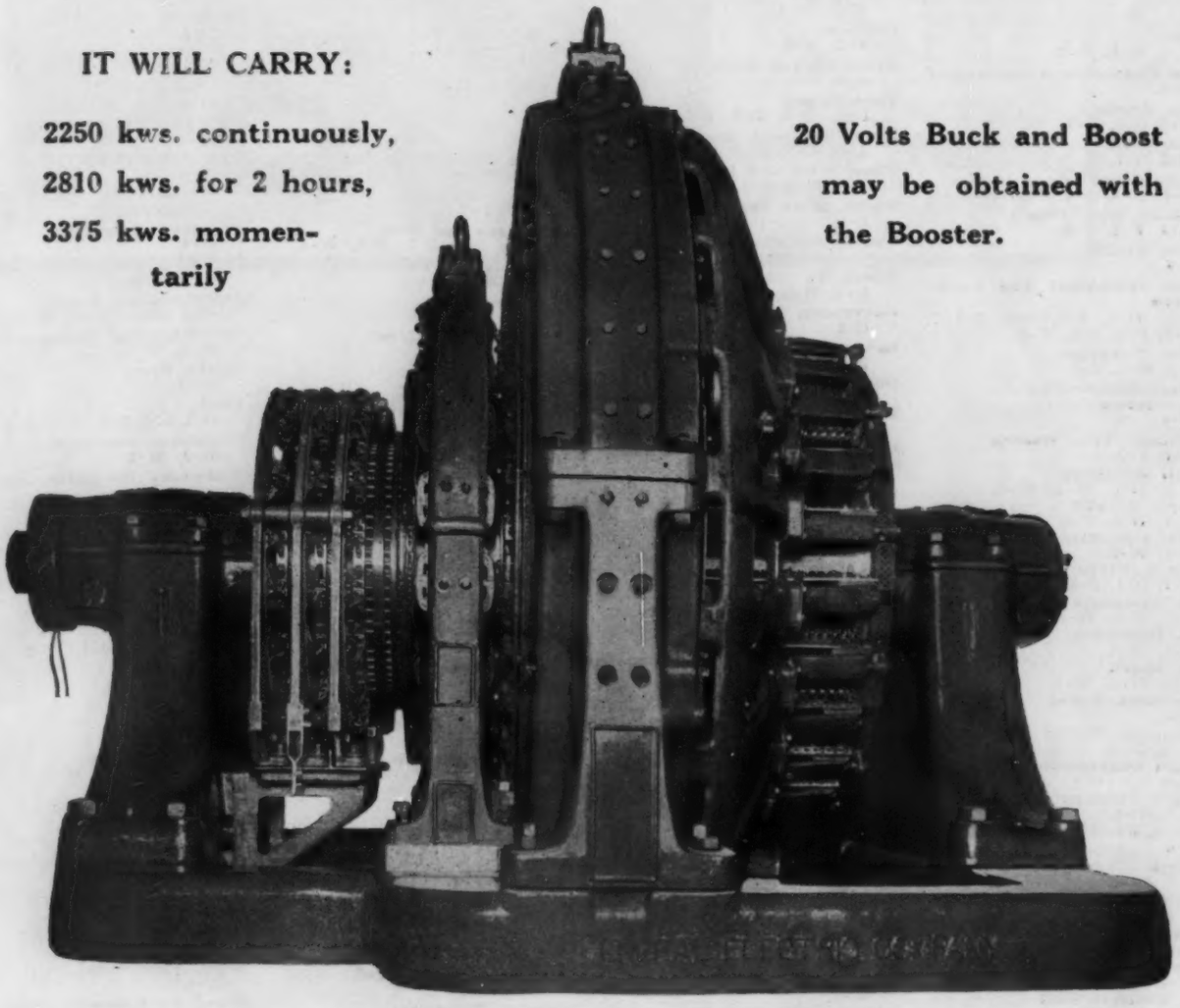

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